

REPORT DOCUMENTATION PAGE			<i>Form Approved</i> OMB NO. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comment regarding this burden estimates or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE April 1998		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE Dynamic Simulation and Path Planning for Virtual Environments			5. FUNDING NUMBERS DAAH04-93-D-0001	
6. AUTHOR(S) Dr. Ming Lin				
7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES) University of North Carolina at Chapel Hill Chapel Hill, NC 27599-1350			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Office P.O. Box 12211 Research Triangle Park, NC 27709-2211			10. SPONSORING / MONITORING AGENCY REPORT NUMBER AR036449.1-MA	
11. SUPPLEMENTARY NOTES The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other documentation.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12 b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)				

The PI and his students have developed novel algorithms for collision detection, 3D polyhedral morphing and view frustrum culling. These include use of noval hierarchical data structures and geometric techniques for interactive occlusion culling, general 3D mapping algorithm and efficient collision detection between general polygonal models.

The resulting algorithms and systems have been applied to a number of applications and the technology has been transferred to a number of research labs and academic institutes, as well as commercial vendors.

DTIC QUALITY INSPECTED 2

14. SUBJECT TERMS Collision Detection, Virtual Environments			15. NUMBER IF PAGES 3	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OR REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

ATTN: AMXRO-ICA (Mrs. Sandra Yates)

REGARDING: 36449-MA

19980519 164

Contract No. DAAH04-93-D-0001

PROJECT TITLE: Dynamic Simulation and Path Planning for Virtual Environments

Name(s) of Principal Investigator(s): Ming C. Lin

Name of Organization: University of North Carolina at Chapel Hill

Address, including ZIP Code: Department of Computer Science, Chapel Hill,
NC 27599-3175

Telephone Number: (919) 962-1974

FAX Number: (919) 962-1799

Email Address: lin@cs.unc.edu

WWW Homepage: <http://www.cs.unc.edu/~lin>

1. Technical Objectives and Motivation

We are addressing some fundamental research issues in dynamic simulation and path planning for virtual environments and electronic prototyping. Our emphasis is to develop better algorithms and software systems and to demonstrate their applications. The set of problems include:

- A. Rapid and accurate algorithms for collision detection and distance computation between general geometric models and deformable bodies
- B. Robust and efficient system implementation and software libraries based on the proposed algorithms
- C. Applications to virtual environments and electronic prototyping

2. Approach

We are utilizing number of techniques from algebraic geometry, approximation theory, computational geometry, numerical analysis, computer-aided geometric design and computer graphics to investigate the underlying mathematical concepts and to develop more efficient and robust geometric algorithms. This includes algorithms and systems for computing correspondence between two general polyhedra, occlusion culling and interactive collision detection between moving objects.

3. Significant Accomplishments

The PI and his students have developed novel algorithms for collision detection, 3D polyhedral morphing and view frustrum culling. These include use of novel hierarchical data structures and geometric techniques for interactive occlusion culling, general 3D mapping algorithm and efficient collision detection between general polygonal models.

The resulting algorithms and systems have been applied to a number of applications and the technology has been transferred to a number of research labs and academic institutes, as well as commercial vendors.

4. Cooperation with and Technology Transfer to Army Laboratories and Other Organizations

{\bf I-COLLIDE, RAPID and V-COLLIDE Collision Detection Systems:}
More than 1200 users all over the world have copied the source code of the I-COLLIDE, RAPID and V-COLLIDE collision detection systems.
Some of the prominent users are at Sandia National Labs, Lockheed Martin, Ford Motor Company, Division, Engineering Animation, Army Research Labs, Evans and Sutherland, etc. The system has also been licensed to Mechanical Dynamics Inc., Division, Prosolvvia etc.

5. Publications in Refereed Journals and Conference Proceedings

{\sf A. Gregory, A. State, M. Lin, D. Manocha and M. Livingston},
''Feature-based Surface Decomposition for Correspondence and Morphing between Polyhedra'', to appear in the Proceedings of Computer Animation, June 1998.

{\sf S. Krishnas, G. Meenakshi, M. Lin, D. Manocha and A. Pattekar},
''Rapid and Accurate Contact Determination between Spline Models Using ShellTrees'', to appear in the Proceedings of Eurographics, September 1998.

{\sf S. Krishnas, A. Pattekar, M. Lin and D. Manocha},
''Spherical Shells: A Higher Order Bounding Volume for Fast Proximity Queries'', in the Proceedings of {\em International Workshop on Algorithmic Foundation of Robotics}, Houston, TX, March 1998.

{\sf Ming C. Lin and Dinesh Manocha} (1997),
''Efficient Contact Determination in Dynamic Environments'',
in the Special Issue of {\em International Journal of Computational Geometry and Applications}, Vol. 7, No. 1 \& 2, pp. 123-151.

{\sf Madhav K. Ponamgi, Dinesh Manocha and Ming C. Lin} (1997),
''Incremental Algorithms for Collision Detection between Polygonal Models'',
in {\em IEEE Transaction on Visualization and Computer Graphics}, Vol. 3, No. 1, Jan-Mar 1997, pp. 51--64.

{\sf T. Hudson, D. Manocha, J. Cohen, M. C. Lin, K. Hoff, H. Zhang},
''Accelerated Occlusion Culling using Shadow Frusta'',
in the {\em 13th ACM Symposium on Computational Geometry}, pp. 1-10, Nice, France, 1997.

{\sf Tom Hudson, Ming C. Lin, Jon Cohen, Stefan Gottschalk and Dinesh Manocha}, ''V-COLLIDE: Accelerated Collision Detection for VRML'',
in the {\em Proceedings of ACM Symposium on Virtual Reality Modeling Language Symposium}, pp. 119-125, Monterey, CA, 1997.

6. Awards and Honors (if any, omit this section if none)

Honda Research Initiation Award

7. Papers or reports in non-refereed publications

None

8. Books or book chapters published

{\sf Ming C. Lin and Dinesh Manocha} (1998),
''Applied Computational Geometry'', Invited Contribution,
{\em Encyclopedia of Computer Science and Technology},
Vol. 38, No. 23, pp. 17-28,
edited by A. Kent and J. G. Williams, Marcel Dekker, Inc.

{\sf Ming C. Lin} (1997),
''Building Simulations for Virtual Environments and Prototyping''
Award Winning Papers on Army Sciences and Technology,
pp. 34-38, published by {\em World Scientific}.

item {\sf Ming C. Lin, Dinesh Manocha, Jonathan D. Cohen and Stefan
Gottschalk} (1997),
''Efficient Algorithms for Interference Detection in Dynamic Environments'',
in the book {\em Product Modeling for Computer Integrated Design and
Manufacture}, edited by M. Pratt, R. D. Sriram and
M. J. Wozny, Chapman \& Hall, pp. 334--346.

9. Patent/Inventions filed or granted

None

10. Number of graduate and undergraduate students supported by gender and by
minority group

Arthur Gregory (BS, Dec 1997; male)
Amol Pattekar (MS expected in May 1998; male)
Stefan Gottschalk (Ph.D. expected in August 1998; male)
Gentaro Hirota (Ph.D. expected in 2000/2001; male)

11. Number of MS and Ph.D. degrees awarded to students working through
the grant and their current employment status and employers

None at this time

12. Nonexpendable instrumentation purchased; value thereof

None